**53 (CE 403) GTEN**

**2014**

# GEOTECHNICAL ENGINEERING

**Paper : CE 403**

*Full Marks : 100*

*Pass Marks : 30*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

*Answer* ***question no. 1*** *and* ***any four*** *from the rest.*

1. *(a)* Differentiate between — 4×3=12

   *(i)* Loose packing and dense packing of soil.

   *(ii)* Orientation and induction effect.

   *(iii)* Kaolinite and montmorillonite mineral.

   *(iv)* Residual and transported soil.

(b) Fill in the blanks : 8

(i) Consolidation is a process associate with the property of ———— of soil mass.

(ii) Coefficient of ———— is defined as the decrease in vol. of soil mass per unit vol. due to unit increase in pressure.

(iii) The degree of compaction of soil is measured is terms of ——— weight.

(iv) The tests carried out in order to classify a soil are termed as ———— .

(v) Toughness index gives an idea about the ———— of a soil at plastic limit.

(vi) The liquid limit is determined by reading the water content corresponds to ———— blows on the flow curve.

(vii) The two fundamental building blocks ———— involved in the formation of clay mineral.

(viii) The bonding between layers of kaolinite mineral are ——— forces and ——— bones.

2. (a) What are the components of total settlement of a loaded soil ? Discuss in details. 8

(b) A clay soil, tested in a consolidometer, showed a decrease in void ratio from 1·2 to 1·1 when the pressure was increased from 0·25 to 0·5 $kgf/cm^2$. Calculate the coefficient of compressibility and coefficient of volume compressibility. If the coefficient of consolidation determined in the test for the given stress increment was $10 m^2/yr$. Calculate the coefficient of permeability in $cm/s$.

If the sample tested at the site was taken from a clay layer $3m$ in thickness, determine the consolidation settlement resulting from the given stress increment. 12

3. (a) List the various factors affecting compaction and discuss *any two* of them is details. 8

(b) The following observations were made in a standard proctor test 12

| | | | | | | |
|---|---|---|---|---|---|---|
| Mass of wet soil | 1·7 | 1·89 | 2·03 | 1·99 | 1·96 | 1·92 |
| Water content | 7·7 | 11·5 | 14·6 | 17·5 | 19·7 | 21·2 |

Determine maximum dry density and optimum moisture content. Also plot zero air void line given $G = 2{\cdot}67$.

4. (a) What is the role of stress history in consolidation of soil ? How the conversion of normally consolidated soil to over consolidated soil is taking place. 8

(b) Soil of two types 1 and 2 are taken is a permeameter of diameter 8*cm* and water is allowed to flow through them under a head of 30*cm*. 12

(i) If the permeability of soil 1 is $2{\cdot}8 \times 10^{-2}\ cm/s$ and 35% of total head causing flow is lost during flow through this layer, calculate the rate of discharge and permeability for soil 2.

(ii) If the void ratio is 0·55 for soil 1 and 0·7 for soil 2. compute the seepage velocity for flow through each layer.

(iii) Calculate the critical hydraulic gradient for upper soil and lower soil.

5. *(a)* Define the following : 8

*(i)* Consistency of clay

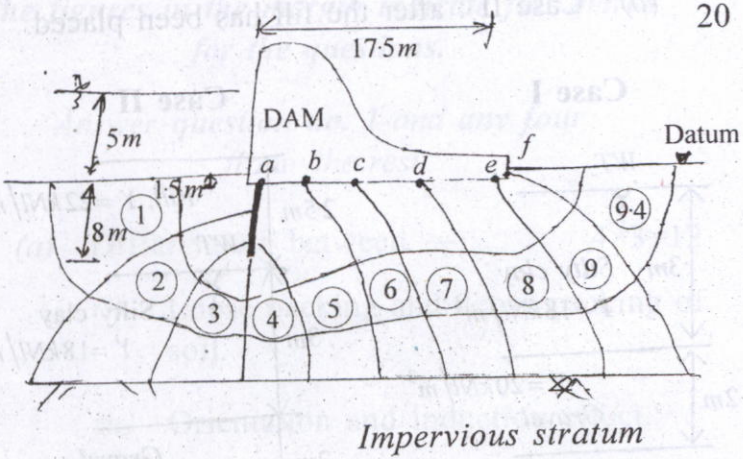
*(ii)* Consistency states

*(iii)* Alterberg limits

*(iv)* Alterberg indices.

*(b)* 1 *cum* of wet soil weighs $20\,kNl$. Its dry weight is $18kNl$ $G = 2{\cdot}67$. Determine the water content, porosity, void ratio and degree of saturation. Draw a phase diagram. 12

6. 20




*(i)* Compute the seepage flow below the dam.

(ii) If the coefficient of permeability is $2 \times 10^{-3}\ cm/s$, calculate total head, pressure head and uplift pressure at points *a*, *b*, *c*, *d*, *e* and *f*.

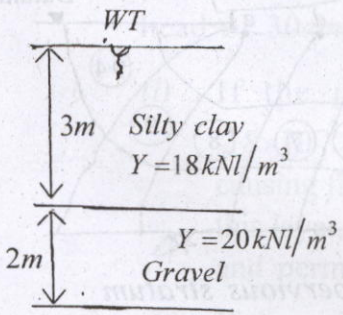
(iii) Also calculate the unit gradient.

7. Assuming that the water table remains at the surface of the silty clay draw the effective stress profiles for — 20

(i) Case I : before the fill is placed.

(ii) Case II : after the fill has been placed.

**Case I**




**Case II**